James Thomson and the Continuity of the Solid, Liquid, and Gaseous State

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James Thomson (1822-1892) was the elder brother of Sir William Thomson (1824-1907) who became Lord Kelvin of Largs in 1892. Although much less known than his younger brother, James Thomson was among the preeminent British scientists during the second half of the 19th century and made important contributions along four trains of thought: fluid dynamics, congelation and liquefaction, the continuity of states of matter, and dynamics and elasticity of materials and structures. A four-page report about one of his lectures in 1871 [1] contains not only his proposal of S-shaped connections between the gas and the liquid branches of subcritical pressure-volume isotherms of pure compounds. He also inferred in it the coexistence of the solid, liquid, and gaseous form of pure compounds at a point which he called ìtriple point.î Since his first publication in 1847 on the effect of pressure in lowering the freezing point of water, Thomsonís work included solids and he tried to develop an integral understanding of the three phases of matter. The publication of van der Waalsí thesis in 1873 swept the general interest in thermodynamics to focus on vapors, liquids, their equilibria, and critical points and Thomsonís work was forgotten.

It is worthwhile to take James Thomsonís broad thinking as a reference to examine how our understanding of the three phases of matter has progressed from then until now. What equations of state are capable to represent all three phases of matter, including the solid? What is the structure of such equations and their quality of representation? What metastable regimes do they involve in the vicinity of the triple point in comparison with experimental data and theoretical results? These are some of the questions to be discussed in this presentation.

[1] James Thomson, *Rep. Brit. Assoc. Adv. Sci*., **41**, 30 (1871).